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U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO. 1044

TASK ASSIGNMENT NPG-Re3b-239-1-52

1st Partial Report

5" ANTI-SUBMARINE PROJECTILE EX-30

1st Partial Report

Task Assignment NPG-Re2b-239-1-52

Copy No. 11

Classification CONFIDENTIAL SECURITY INFORMATION

5" Anti-Submarine Projectile EX-30

PART A

SYNOPSIS

1. a. In order to increase anti-submarine fire power without increasing naval armament the Bureau of Ordnance desires to develop an anti-submarine projectile which can be fired from a 5"/38 shipboard gun to a range of approximately 2000 yards.

b. This projectile must have adequate structural strength to withstand the forces of being fired from a gun at an initial velocity of 300 to 500 ft./sec.. Its air and water trajectories must be relatively stable with a minimum amount of dispersion and with consistently good water entry characteristics.

2. This test was conducted to determine:

a. A satisfactory assembly and method of firing the subject projectiles from a 5"/38 gun.

b. A propellant powder charge to obtain projectile velocities of 300 to 500 ft./sec..

c. The yaw and spin rate of the EX-30 projectile.

d. The mechanical survival of the projectile by studying the appearance of the projectile in-flight and following recovery.

3. It is concluded that the 5" A.S. projectile was successfully fired from a worn 5"/38 Mark 12 Mod 1 gun at velocities of 170 f/s to 517 f/s, at a range of 200 feet. The projectile exhibited (a) satisfactory structural strength, (b) negligible spin, (c) relatively stable flight with an approximate yaw of 5° to 15°.

5" Anti-Submarine Projectile EX-30

TABLE OF CONTENTS

PART B

INTRODUCTION

1. AUTHORITY:

This program was authorized by reference (a) under Task Assignment NPG-Re3b-239-1-52.

2. REFERENCES:

a. BUORD ltr Re3b-AAF:bc NORD 9987 Ser 27413 of 24 October 1951
b. Report No. 21, Contract NORD-9987, Alden Hydraulic Laboratory, Worchester Polytechnic Institute
c. NAVPROV Moments of Inertia Form Sheet No. MISC. 18 of 13 March 1952
d. NAVPROV Moments of Inertia Form Sheet No. MISC. 20 of 17 March 1952

3. BACKGROUND:

a. The Bureau of Ordnance desires to develop an anti-submarine projectile which can be fired from a 5"/38 shipboard gun to a range of approximately 2000 yards.

b. This projectile must have adequate structural strength to withstand the forces of being fired from a gun at an initial velocity of 300 to 500 ft./sec.. Its air and water trajectories must be relatively stable with a minimum amount of dispersion and with consistently good water entry characteristics.

c. A 1-1/4" scale model of the subject projectile was tested for underwater performance by the Worchester Polytechnic Institute and the test results reported in reference (b).

4. OBJECT OF TEST:

This test was conducted to determine: (a) a satisfactory assembly and method of firing the subject projectiles from a 5"/38 gun; (b) a propellant powder charge to obtain projectile velocities of 300 to 500 ft./sec.; (c) the yaw and spin rate of the EX-30 projectile; (d) the mechanical survival of the projectile by studying the appearance of the projectile in-flight and following recovery.

5. PERIOD OF TEST:

a.	Date Project Letter	24 October 1951
b.	Date Material Received	22 January 1952
c.	Date Commenced Test	6 March 1952
d.	Date Completed Test	19 May 1952

6. REPRESENTATIVES PRESENT:

The following representatives witnessed the ballistic tests:

Mr. A. A. Famiglietti	Bureau of Ordnance, Re3b
Dr. A. Miller	Bureau of Ordnance, Re3d

PART C

DETAILS OF TEST

7. DESCRIPTION OF ITEM UNDER TEST:

5" A.S. EX-30 Projectile: This fin stabilized projectile is shown in Figures 1 and 2 of Appendix (A). The test projectiles differed from the specifications of Figures 1 and 2 in that the tail fin assembly was copper brazed instead of welded and the projectile bodies were zinc anodized instead of coated with a rust preventative compound. The moments of inertia of the vermiculite loaded test projectiles were reported in references (a) and (d).

8. DESCRIPTION OF TEST EQUIPMENT:

Gun:	5"/38 Mark 12 Mod 1 No. 8837 ESR: 3829.61-3829.77 (This is a worn gun with a bore diameter of 5.234 at the origin)
Cartridge Case:	A standard 5" Mark V Cartridge Case modified with runners (steel strips) as shown in Figure 3.
Primer:	A modified Mark 39 primer shown in Figure 4 and designated the XCDB/100.
Propellant Powders:	Black Powder and SPDN 3025 (20mm powder)
Cameras:	The type, location and use are shown in Figure 18.
Recovery Media:	Sawdust bin and sandpile.

9. PROCEDURE:

a. The propellant charge, consisting of black powder and 20mm smokeless powder, was compartmented within the shroud of the EX-30 tail section as shown in Figure 6. The propellant was contained within the tail section by use of the pyralin discs shown in Figure 5. Disc A was cemented to the after end of the shroud. The propellant was then placed between the fins and were enclosed within the shroud as disc B was cemented to the forward edge of the shroud. Disc C was cemented to disc B, with the long tab of C covering the slit of B, in order to insure that propellant powders did not escape through the slit of disc B. It is noted that 344 grams of SPDN 3025 and 80 grams of black powder, used in round 3, completely filled the tail section, thereby making the use of spacers unnecessary. For round 4, which utilized 472 grams of 20mm powder plus 80 grams of black powder, four silk bags containing 32 grams of SPDN 3025 each were scotch-taped to the outside of the shroud to discs B and C immediately in front of each powder section.

b. The tail section, containing the powder charge, was then assembled to the EX-30 projectile which was carefully placed within the modified Mark V cartridge case containing the XCDB/100 primer.

c. This entire assembly was then loaded into the gun and the projectiles were fired at various velocities into the recovery medium, with camera coverage to study projectile flight and determine projectile spin.

d. Still photographs were made of flight cards and recovered projectiles following ballistic test.

10. RESULTS AND DISCUSSION:

a. A detailed firing record is shown in Appendix (F).

b. Photographs of projectiles in flight, recovered projectiles, and flight cards are shown in Figures 7 to 17, inclusive.

c. 16mm and 35mm movie film of projectiles in flight is included in Appendix (E).

d. Rounds 1 and 2 were fired at low velocities and long range photographs of the flight characteristics were obtained.

e. Round 3 was fired as the first attempt to obtain projectile spin measurements in addition to the general flight characteristics. (Spin is introduced to the projectile through the cant of the tail fins). The results of this round indicated that spin measurements could not be obtained with a 35mm Fastax camera and a 35mm lens. A 57mm lens was used with the 16mm and 35mm Fastax cameras during subsequent rounds.

f. The condition of the recovered projectiles from rounds 1, 2, and 3 indicated the possibility that the EX-30 tail sections were damaged during projectile propulsion in the bore.

g. The general flight characteristics (cameras 1 and 2), projectile spin (cameras 5, 6 and 7), and condition of the tail section (cameras 5 and 6) were determined in round 4.

h. The results of round 4 indicated that, in the range of 35 ft. to 90 ft. from the muzzle, projectile spin was negligible. It was estimated, from Figure 12, to be less than 1 turn in 600 calibers. The photographs of the tail section shown in Figure 11 and roll 7 indicate that the tail section was not damaged during flight. This projectile was not recovered as it ricocheted from the sand pile into the river.

i. The condition of the tail section (camera 5), projectile spin (cameras 3, 4 and 5), and general flight characteristics were determined in rounds 5, 6, and 7.

j. The results of round 5, 6, and 7 indicated the tail section was not damaged during flight as shown in rolls 11, 16, and 21 of Appendix (E). Projectile spin was not apparent as shown on rolls 10, 14, 15, 19, and 20. Round No. 5 was recovered intact, after approximately 30 ft. of travel in the sawdust, as shown in Figure 14.

k. A velocity-powder curve indicating the approximate mean velocity obtained in relation to the amount of propellant powder used is shown in Enclosure (G).

PART D

CONCLUSIONS

11. a. It is concluded that the 5" A.A. projectile was successfully fired from a worn 5"/38 Mark 12 Mod 1 gun at velocities of 170 f/s to 517 f/s, at a range of 200 feet. The projectile exhibited (a) satisfactory structural strength, (b) negligible spin, (c) relatively stable flight with an approximate yaw of 5° to 15°.

5" Anti-Submarine Projectile EX-30

The tests upon which this report is based were conducted by:
R. D. CROMWELL, Plate Fuze Battery Officer
Plate Fuze Division
Terminal Ballistics Department
C. B. BLANK, Chemical Engineer
Interior Ballistics Division
Armament Department

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APPROVED: J. F. BYRNE
Captain, USN
Commander, Naval Proving Ground

E. A. RUCKNER
Captain, USN
Ordnance Officer
By direction

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NPG REPORT NO. 1044

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

First Partial Report

on

Task Assignment NPG-Re3b-239-1-52

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First Partial Report

on

5" Anti-Submarine Projectile EX-30

X

Project No.: NPG-Re2b-239-1-52
Copy No.: 11
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Date:

SEP 8 1952

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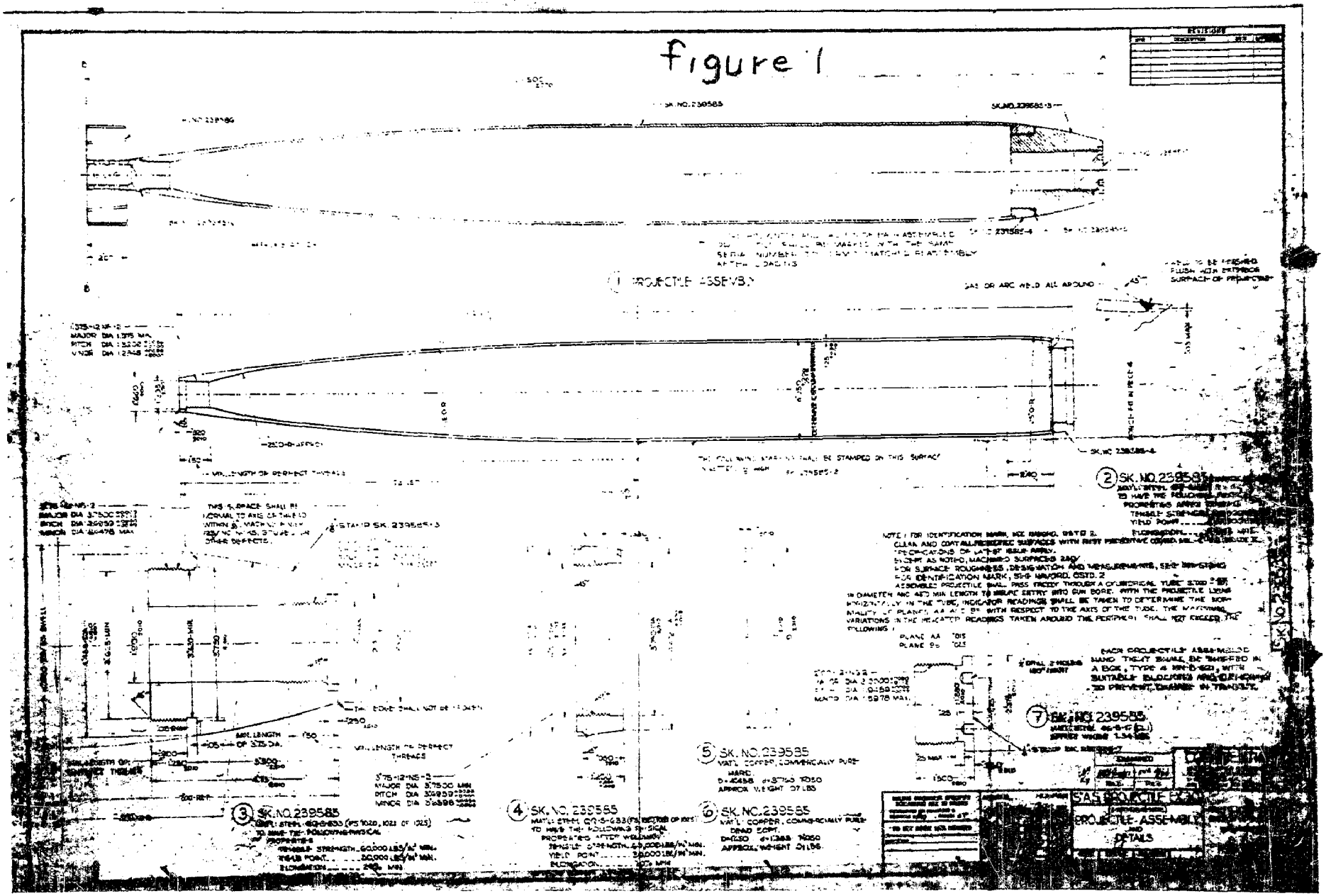
LEGIBILITY POOR...

figure 1



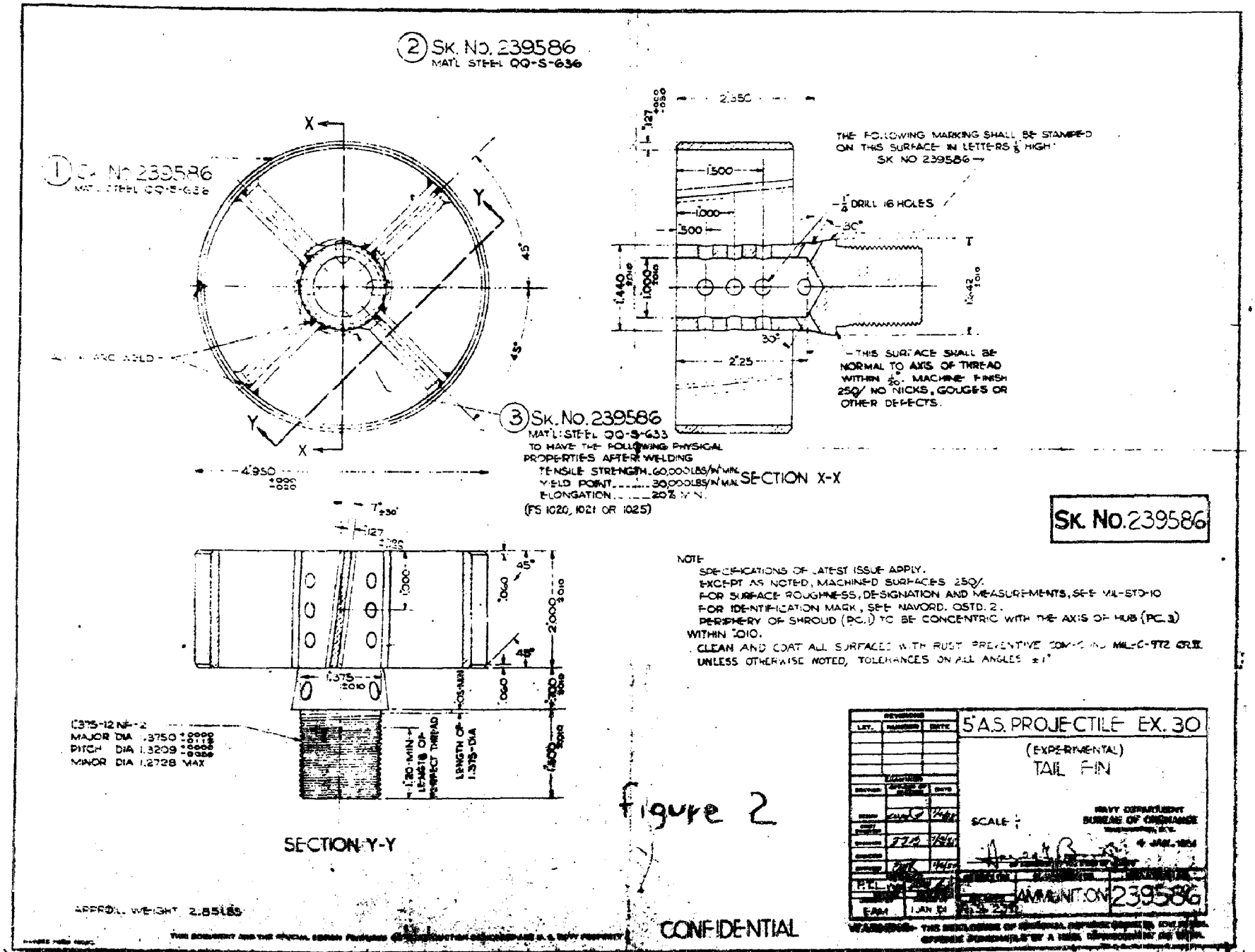
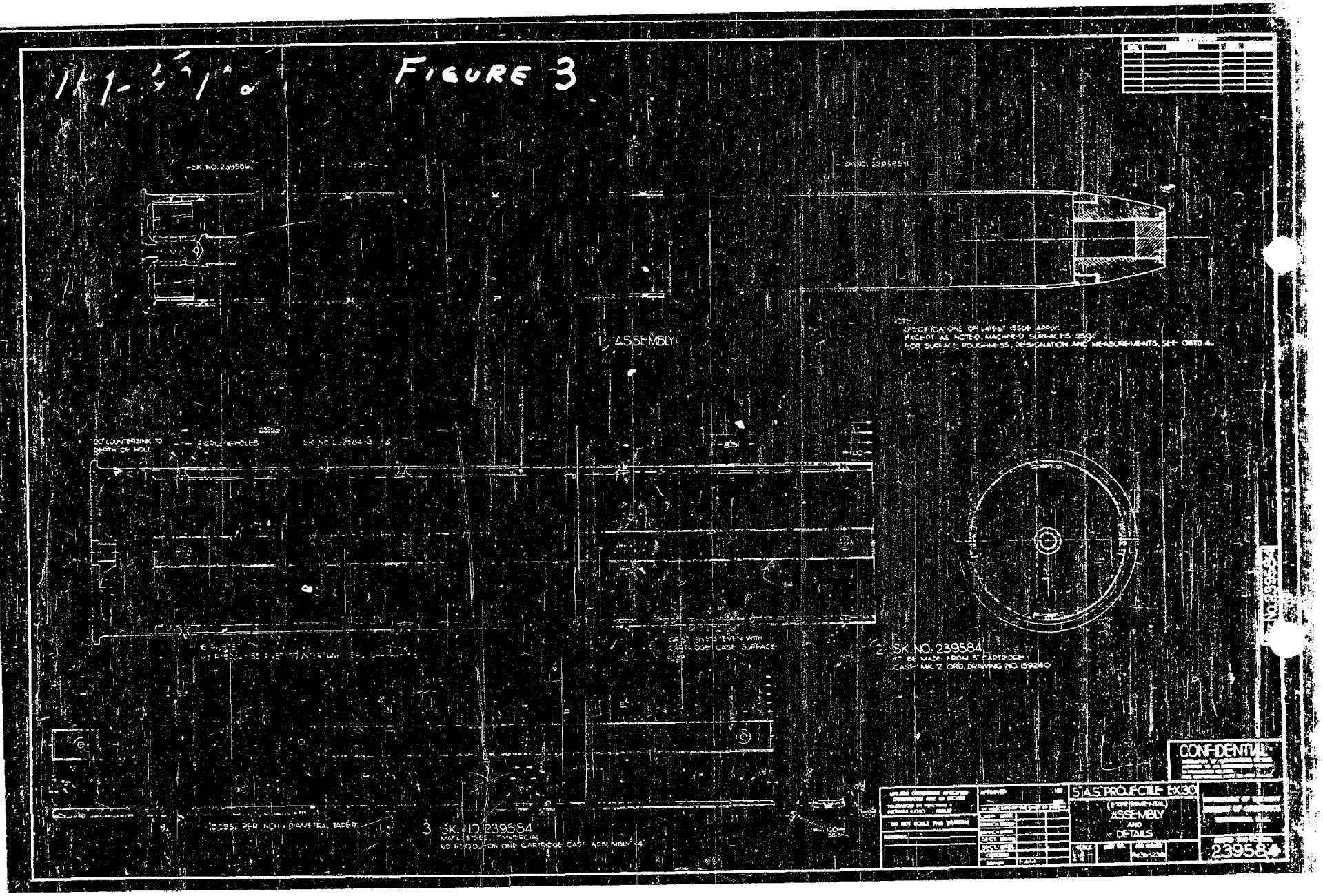

(2) SK. NO. 239586
MAT'L STEEL QQ-S-636
(1) SK. NO. 239586
MAT'L STEEL QQ-S-636
(3) SK. NO. 239586
MAT'L: STEEL QQ-S-633
TO HAVE THE FOLLOWING PHYSICAL PROPERTIES AFTER WELDING
TENSILE STRENGTH..60,000 LBS/IN² MIN.
YIELD POINT.....30,000 LBS/IN² MIN.
ELONGATION.....20% IN 4"
(FS 1020, 1021 OR 1025)
THE FOLLOWING MARKING SHALL BE STAMPED ON THIS SURFACE IN LETTERS 1/8 HIGH
SK NO 239586
1/8 DRILL 16 HOLES
THIS SURFACE SHALL BE NORMAL TO AXIS OF THREAD WITHIN 1/20°. MACHINE FINISH 250/ NO NICKS, GOUGES OR OTHER DEFECTS.
SECTION X-X
SECTION Y-Y
SK. NO. 239586
NOTE
SPECIFICATIONS OF LATEST ISSUE APPLY.
EXCEPT AS NOTED, MACHINED SURFACES 250/.
FOR SURFACE ROUGHNESS, DESIGNATION AND MEASUREMENTS, SEE MIL-STD-10
FOR IDENTIFICATION MARK, SEE NAVORD. OSTD. 2.
PERIPHERY OF SHROUD (PC. 1) TO BE CONCENTRIC WITH THE AXIS OF HUB (PC. 3) WITHIN .010.
CLEAN AND COAT ALL SURFACES WITH RUST PREVENTIVE COMPOUND MIL-C-972 GRADE
UNLESS OTHERWISE NOTED, TOLERANCES ON ALL ANGLES ±1°
5"A.S. PROJECTILE EX. 30
(EXPERIMENTAL)
TAIL FIN
SCALE 1
NAVY DEPARTMENT
BUREAU OF ORDNANCE
AMMUNITION 239586
CONFIDENTIAL

Figure 2

FIGURE 3


1 ASSEMBLY
2 SK. NO. 239584
3 SK. NO. 239554
CONFIDENTIAL
5"AS PROJECTILE MK 30
(EXPERIMENTAL)
ASSEMBLY
AND
DETAILS
239584

XCDB/100 EXPERIMENTAL PRIMER
FOR 5" A.S. PROJECTILE TEST

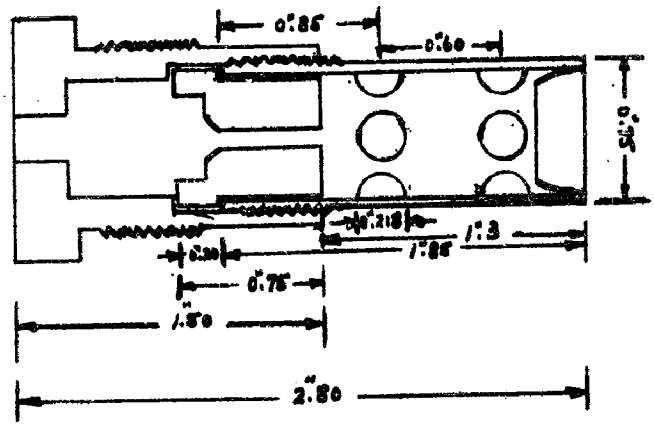


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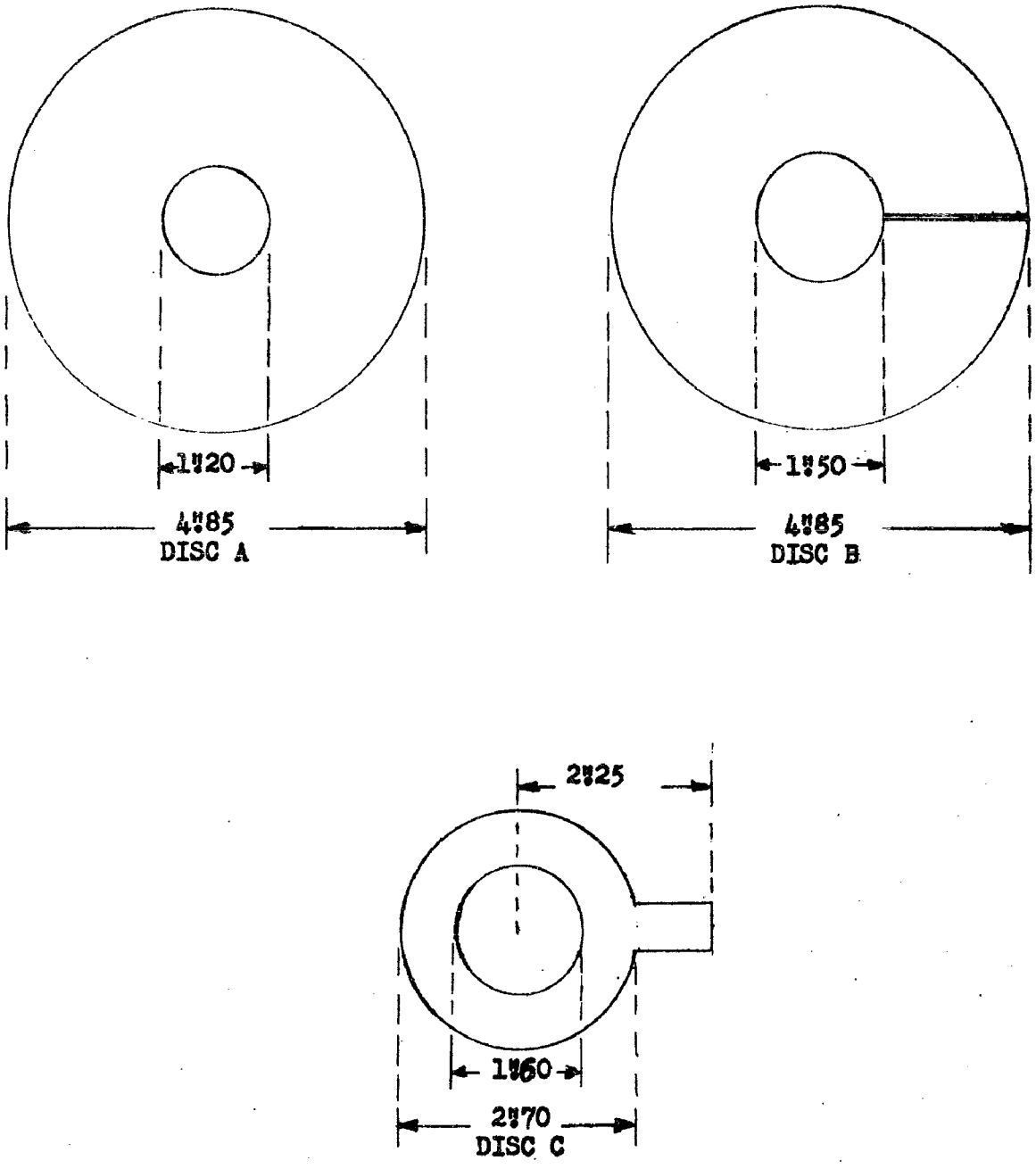
FIGURE 4

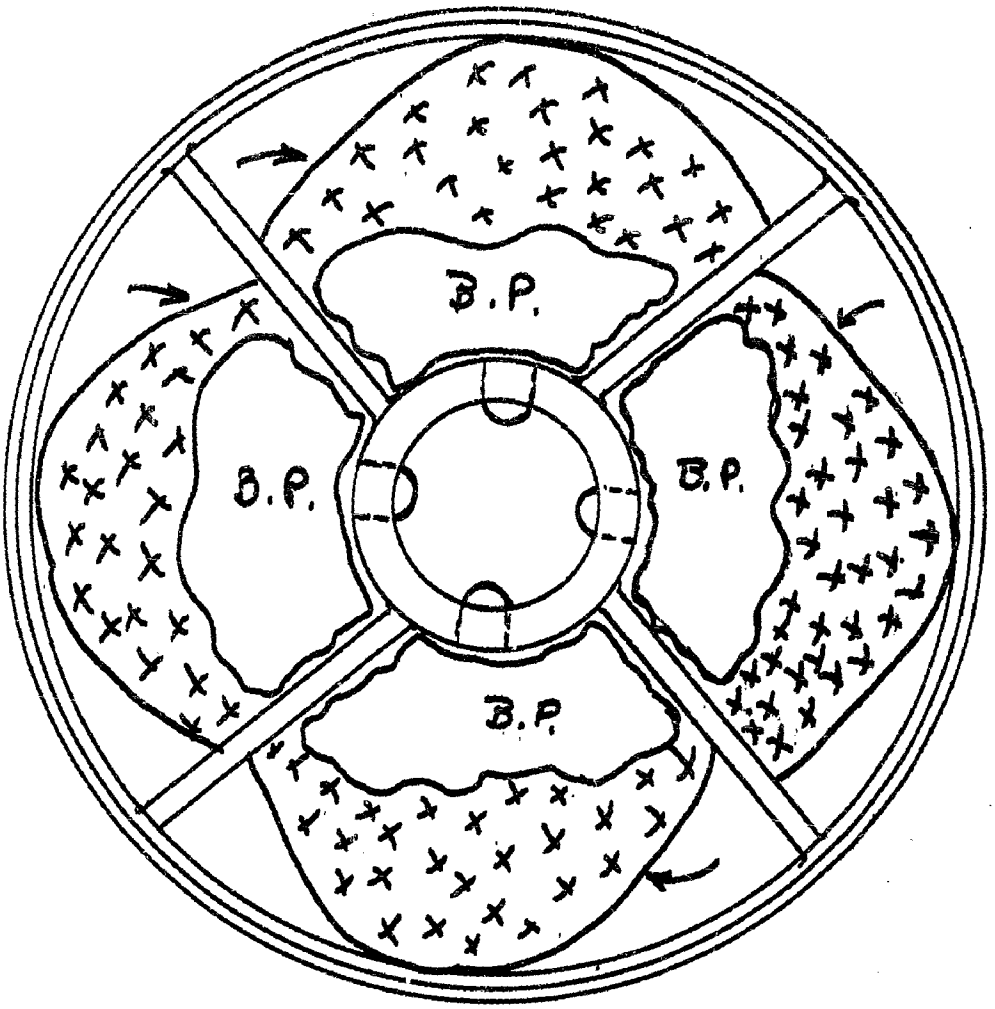
PYRALIN DISCS USED IN
ASSEMBLING POWDER CHARGE



NOTE: Discs were fabricated from 0.040 Pyralin

FIGURE 5

METHOD OF ASSEMBLING
POWDER CHARGE IN TAIL SECTION



NOTE:
B.P. = Black Powder in Silk Bag
XX = 20mm Powder
← = Pyralin Spacer

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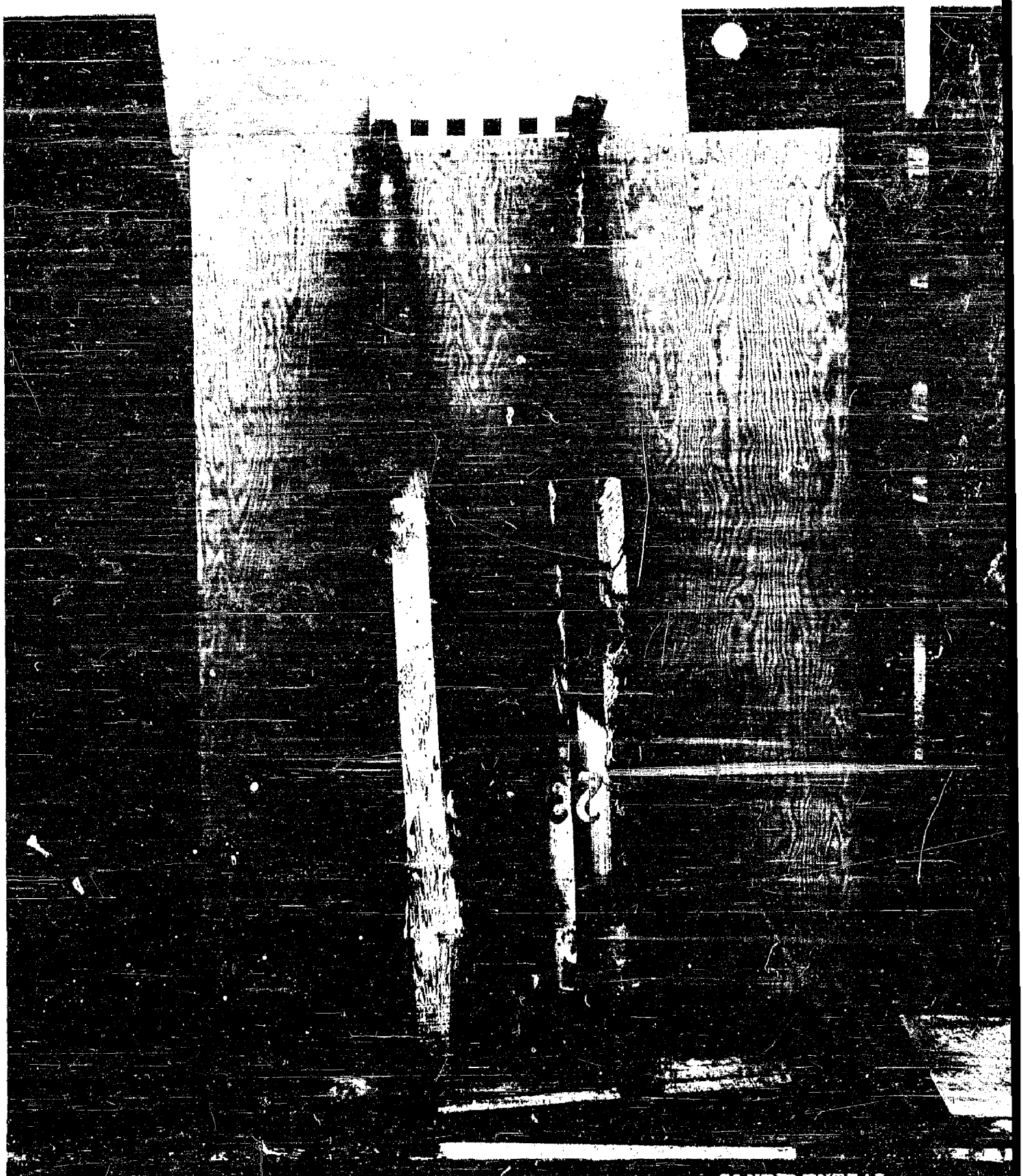
FIGURE 6



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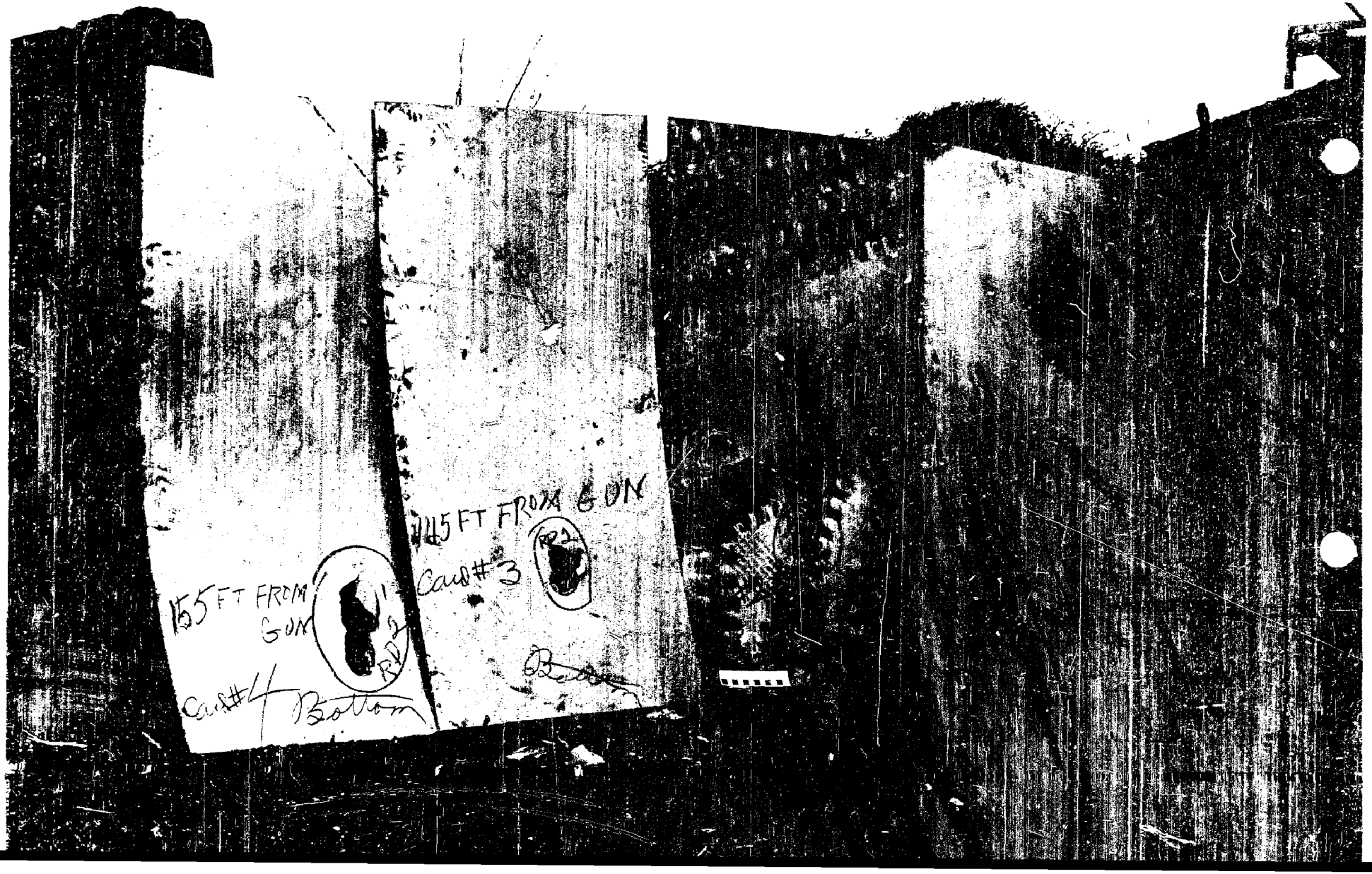
SECURITY INFORMATION

NP9-50683 6 March 1952

5" A. S. Projectiles, EX-30, Nos. 1 and 2 after ballistic test. Round 1 lost tail shroud. Round 2 has tail shroud around body.

Figure 7

NP9-50684 6 March 1952 CONFIDENTIAL
SECURITY INFORMATION
Yaw cards describing flight of 5" A. S. Projectiles, EX-30. Rounds 1 and 2.
Figure 8



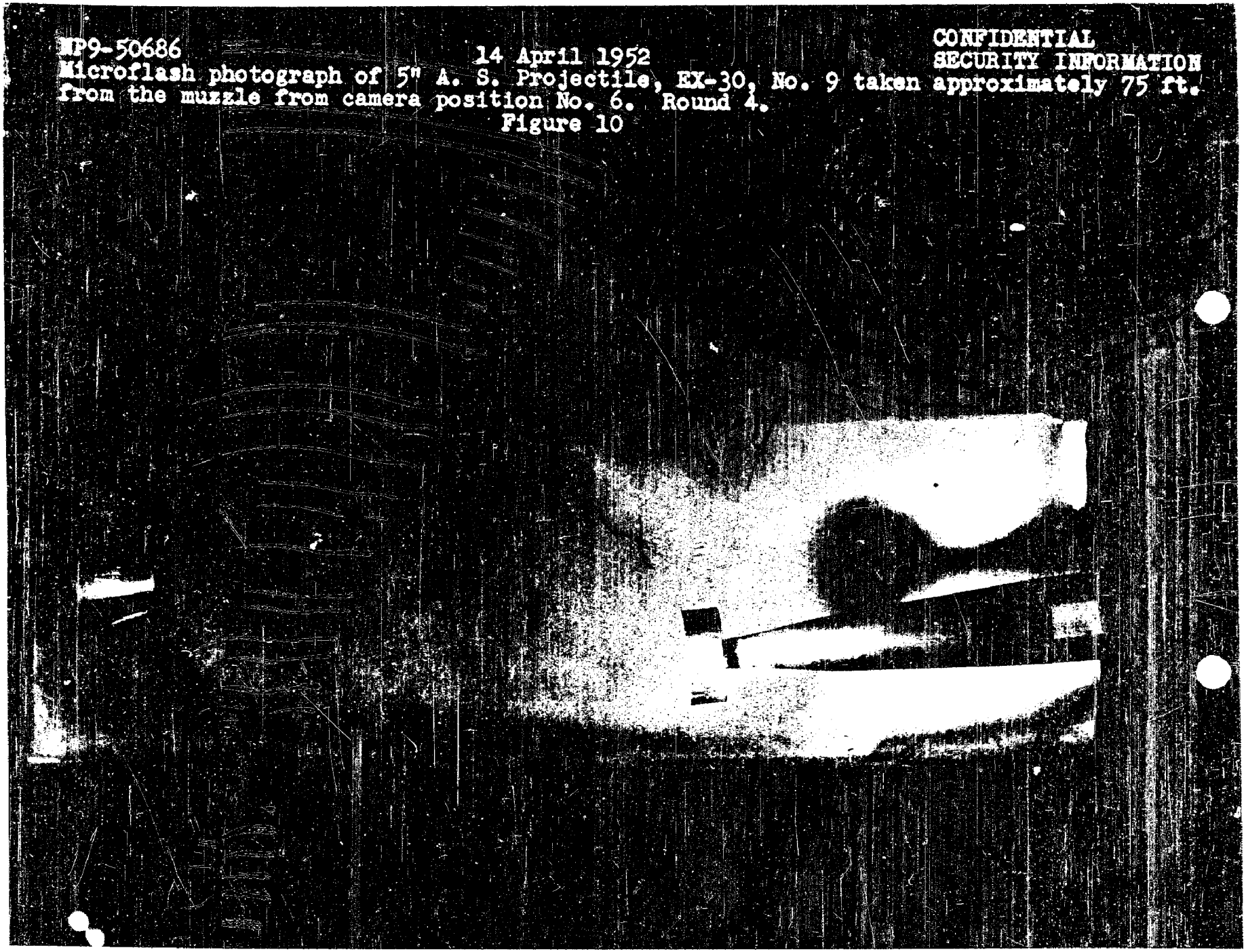
...9-50685 11 April 1952 CONFIDENTIAL SECURITY INFORMATION
...A. E. Projectile, EX-30, No. 5 after recovery from sand. Round 3.
...hree views (120° apart).

Figure 9

NP9-50686 14 April 1952 CONFIDENTIAL SECURITY INFORMATION

Microflash photograph of 5" A. S. Projectile, EX-30, No. 9 taken approximately 75 ft. from the muzzle from camera position No. 6. Round 4.

Figure 10



NP9-50687 14 April 1952

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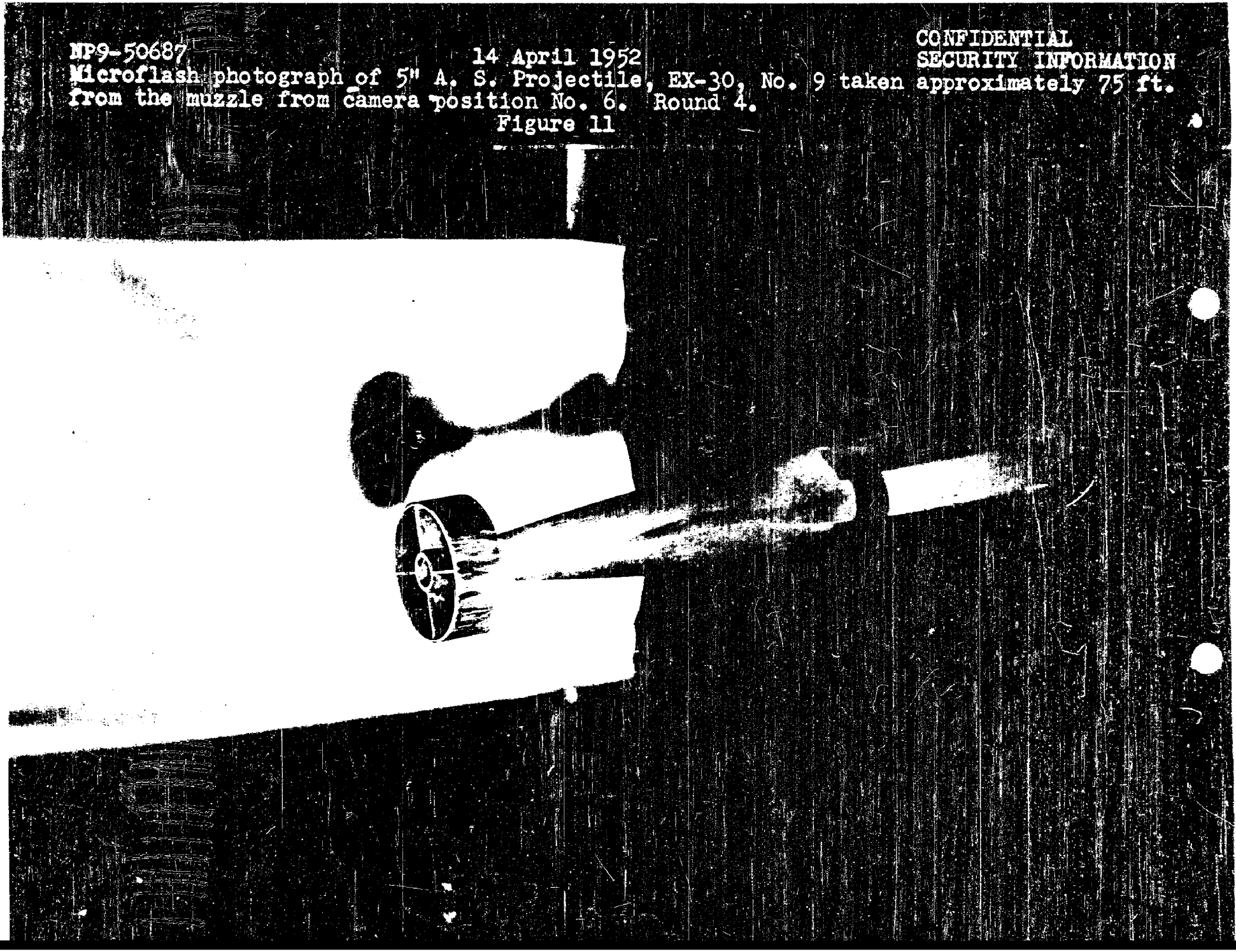
SECURITY INFORMATION

Microflash photograph of 5" A. S. Projectile, EX-30, No. 9 taken approximately 75 ft. from the muzzle from camera position No. 6. Round 4.

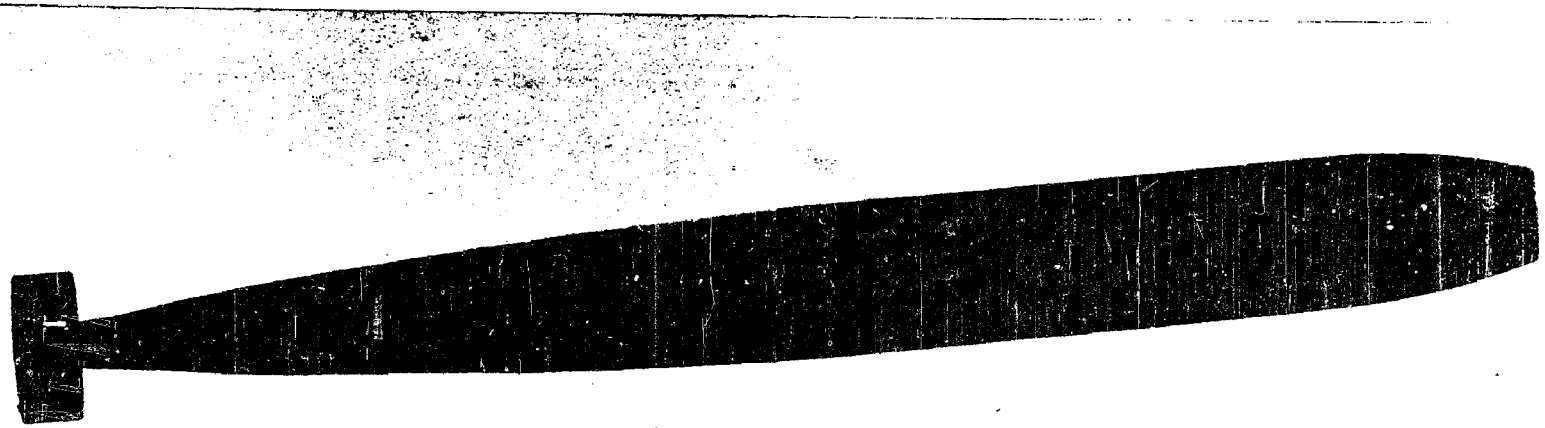
Figure 11



NP9-50688 14 April 1952 CONFIDENTIAL SECURITY INFORMATION

Ballistic-Syncro photograph of 5" A. S. projectile, EX-30, No. 9 taken Approximately 90 feet from the muzzle from camera position No. 7. Round 4.

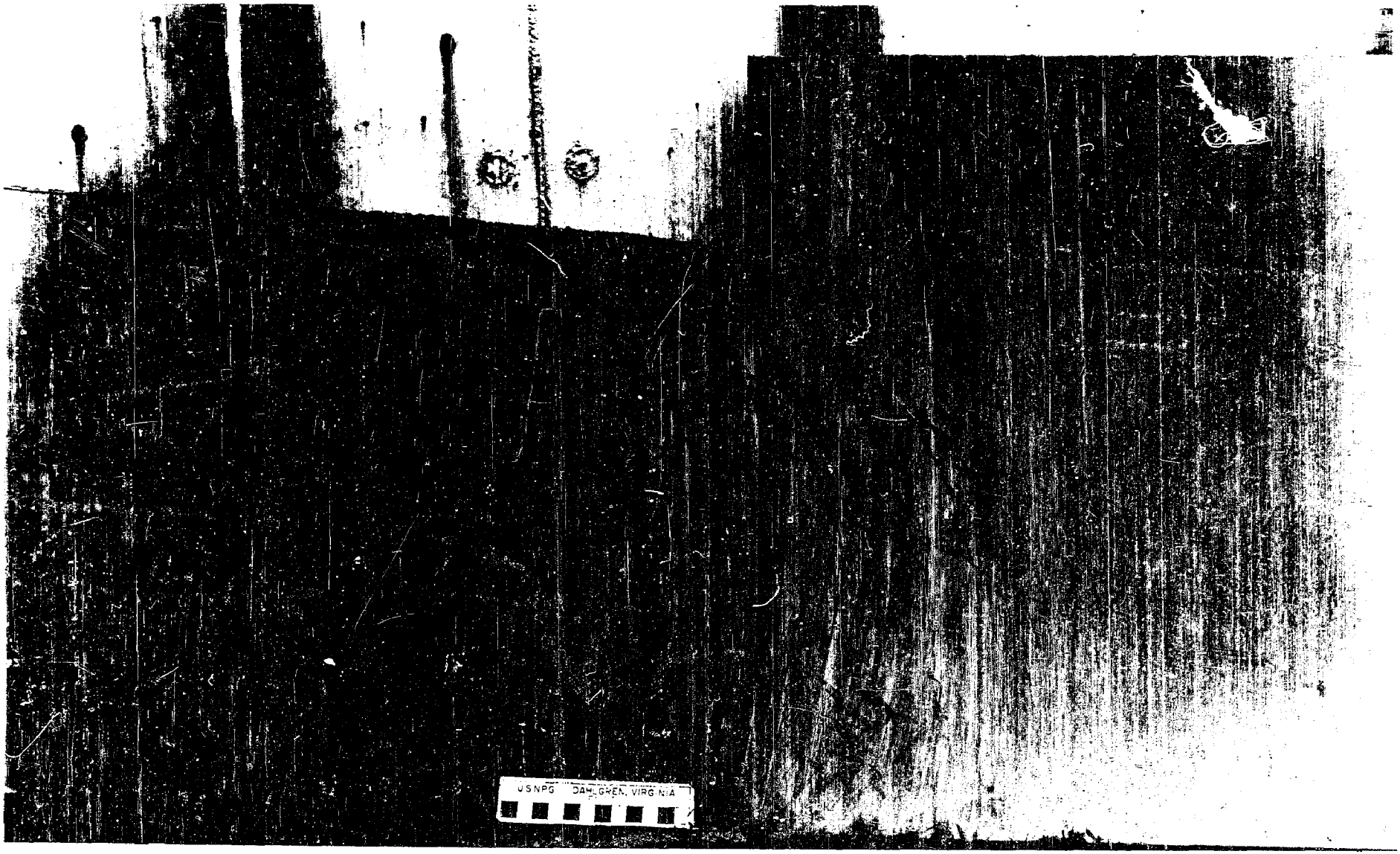
Figure 12

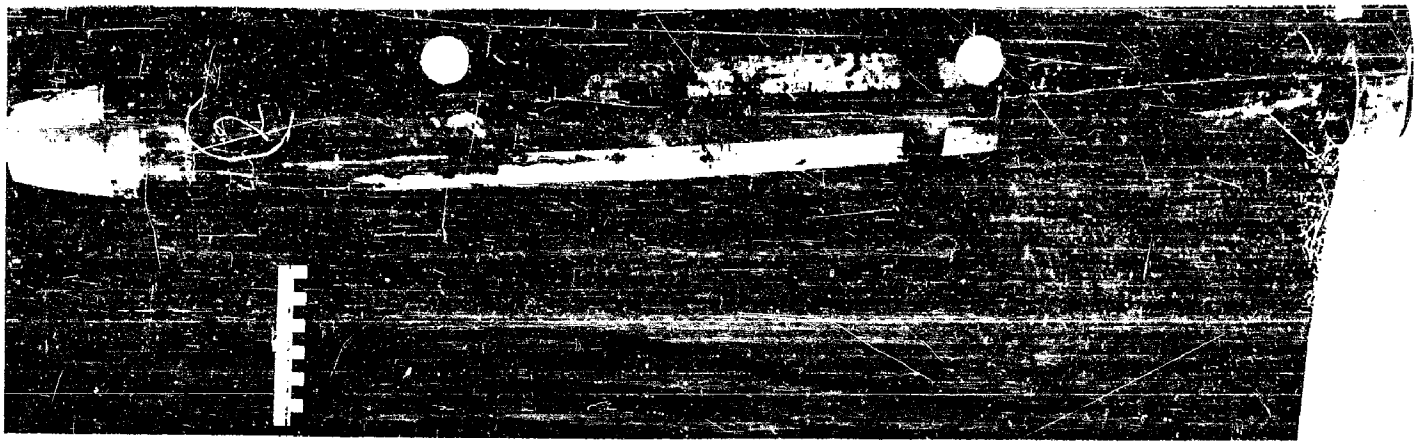


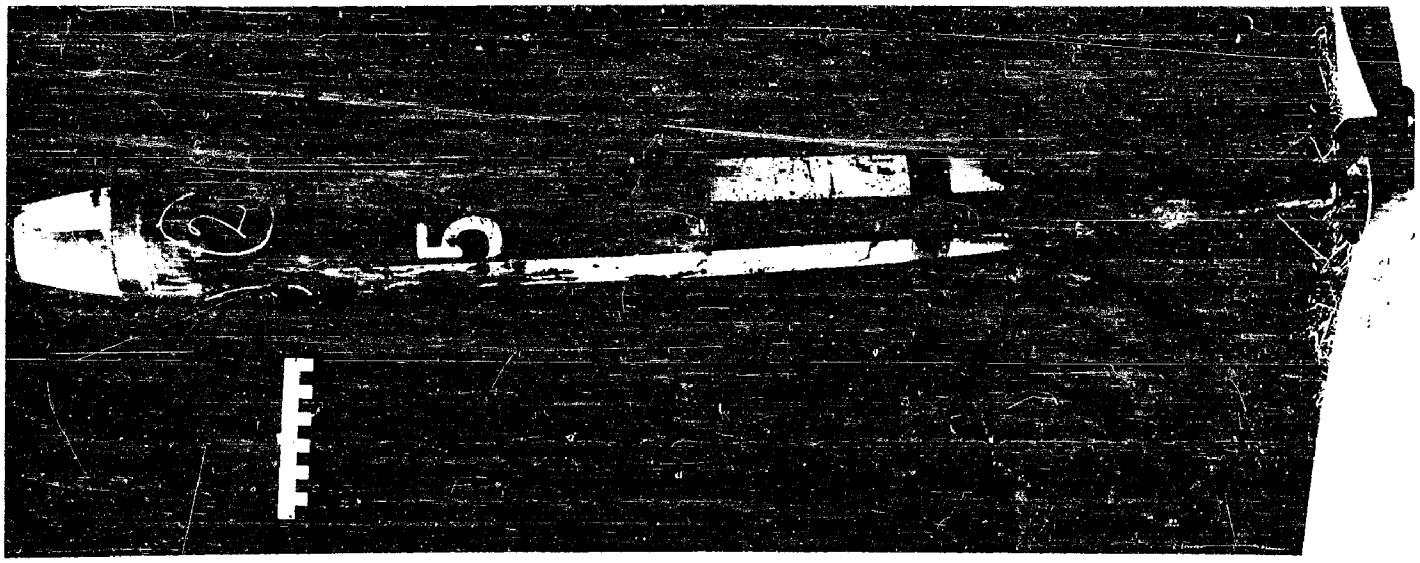
NP9-50689 11 & 14 April 1952 CONFIDENTIAL SECURITY INFORMATION

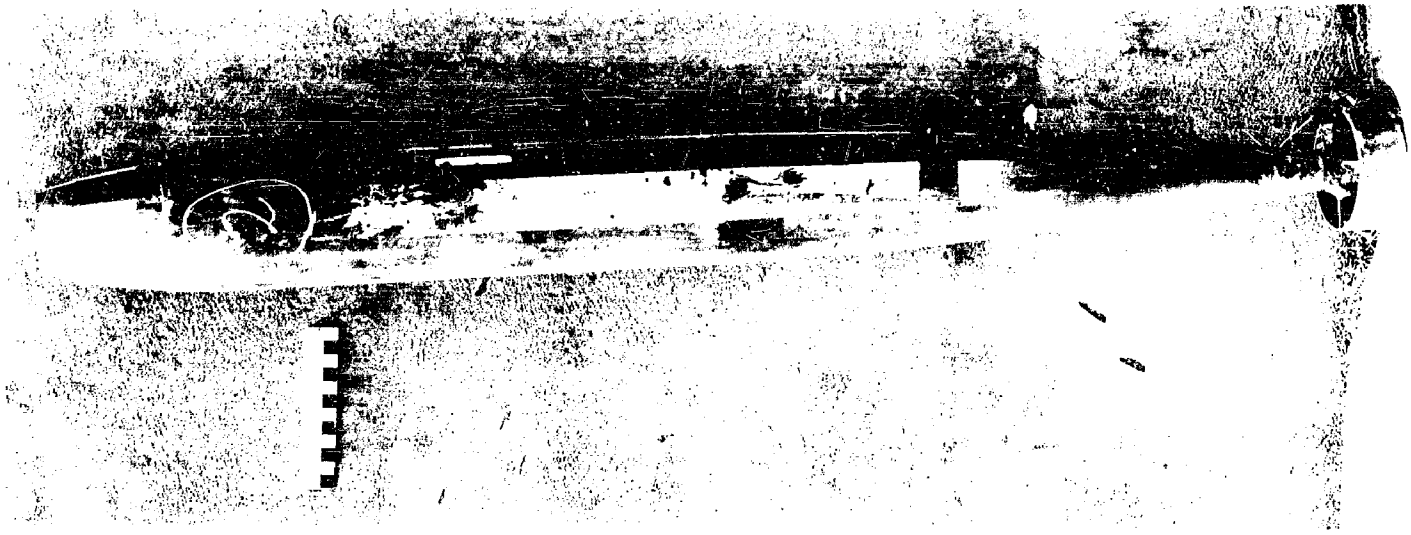
Yaw cards describing flight of 5" A. S. Projectiles, EX-30. Rounds 3 and 4.

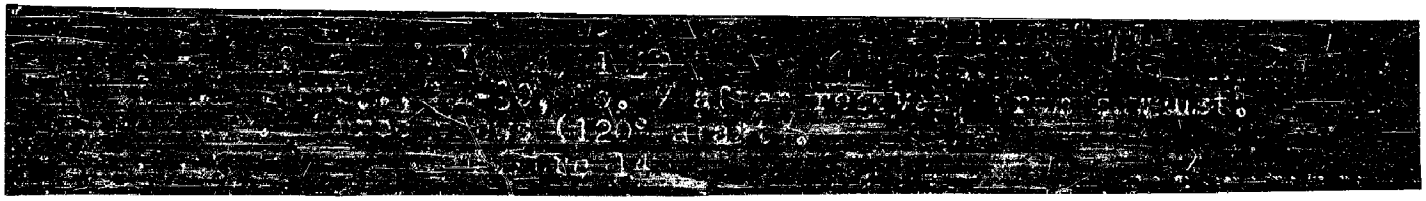
Figure 13

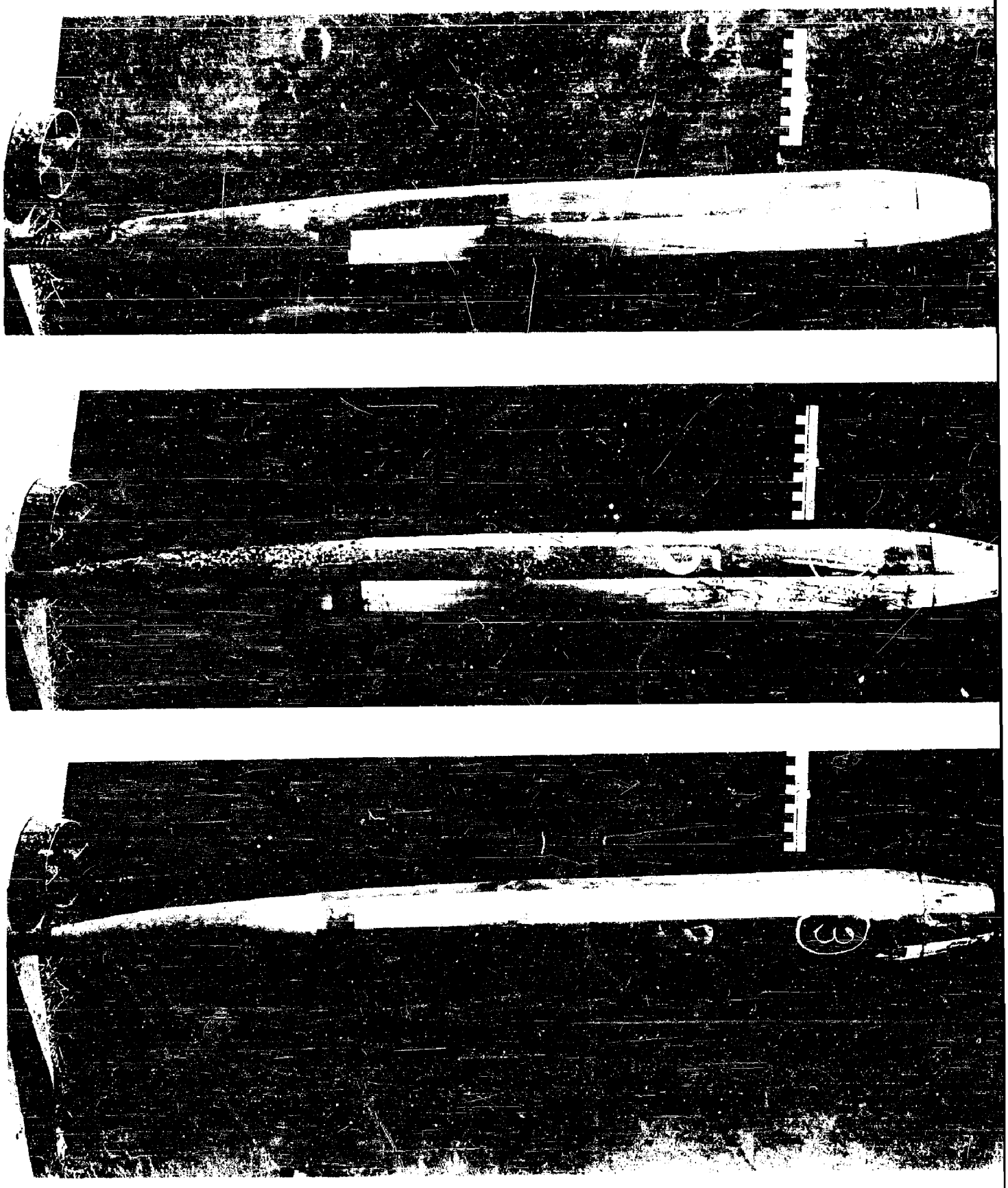












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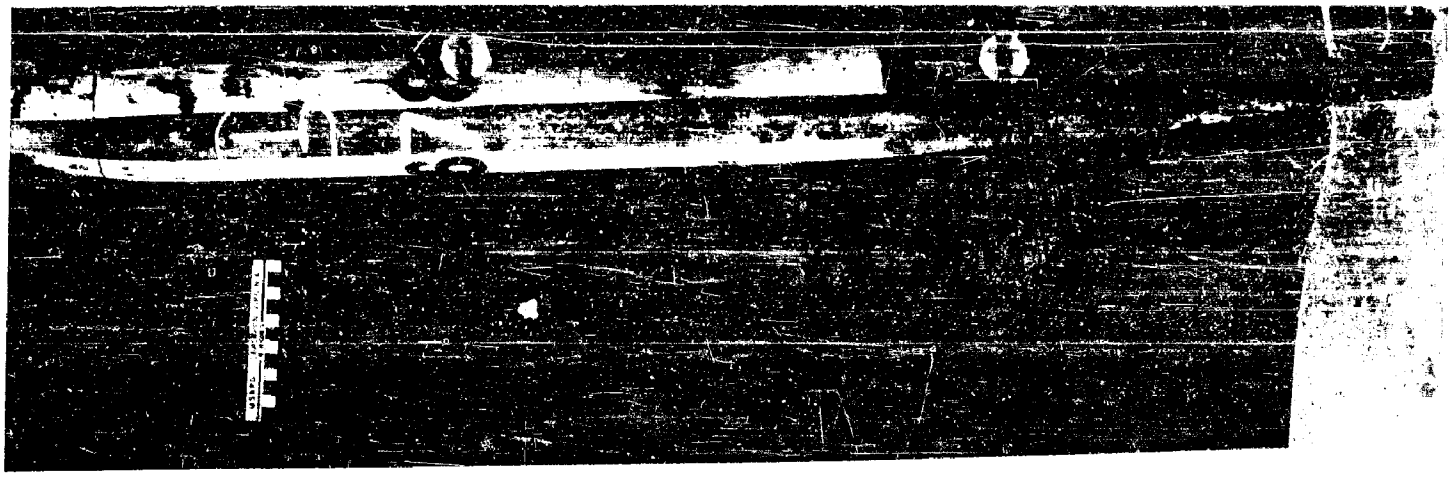
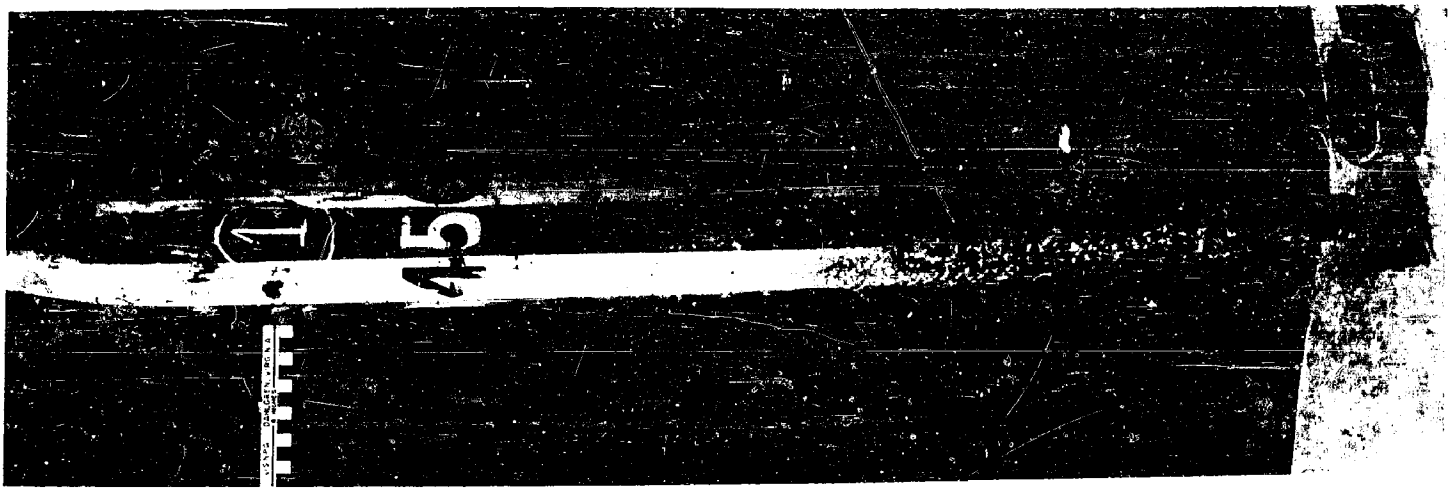
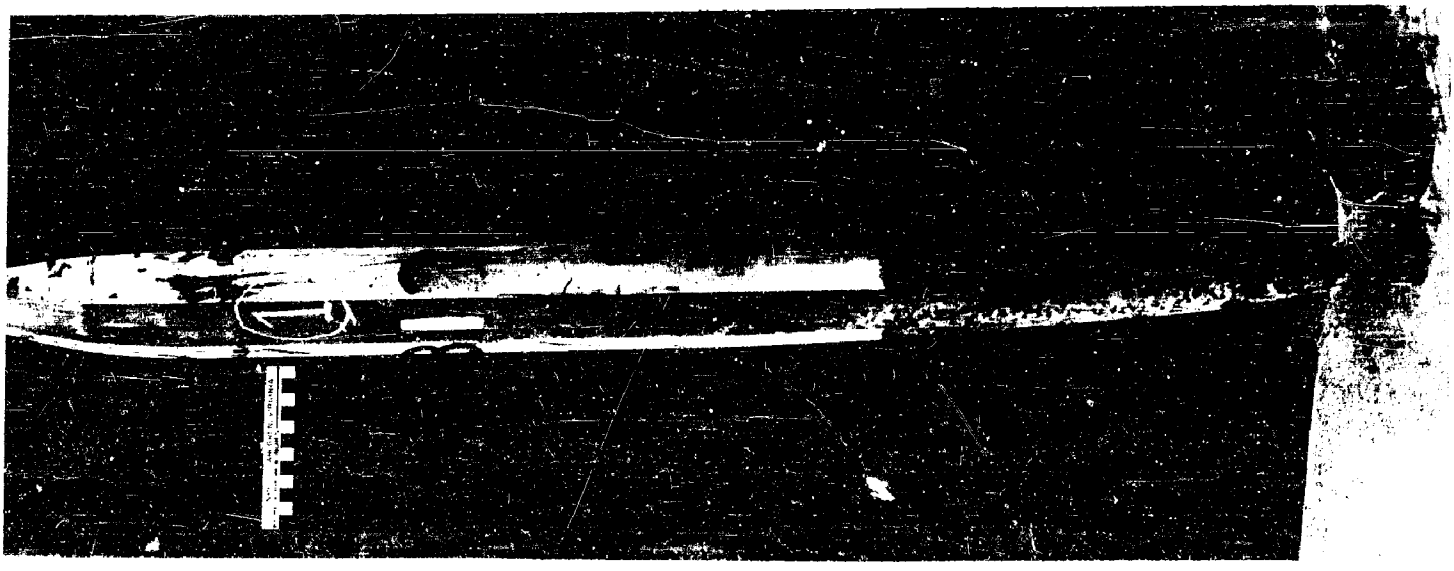
NP9-50691 19 May 1952
5" A. S. Proj., EX-30, No. 6 after recovery from sawdust.
Round 6. Three views (120° apart).
Figure 15







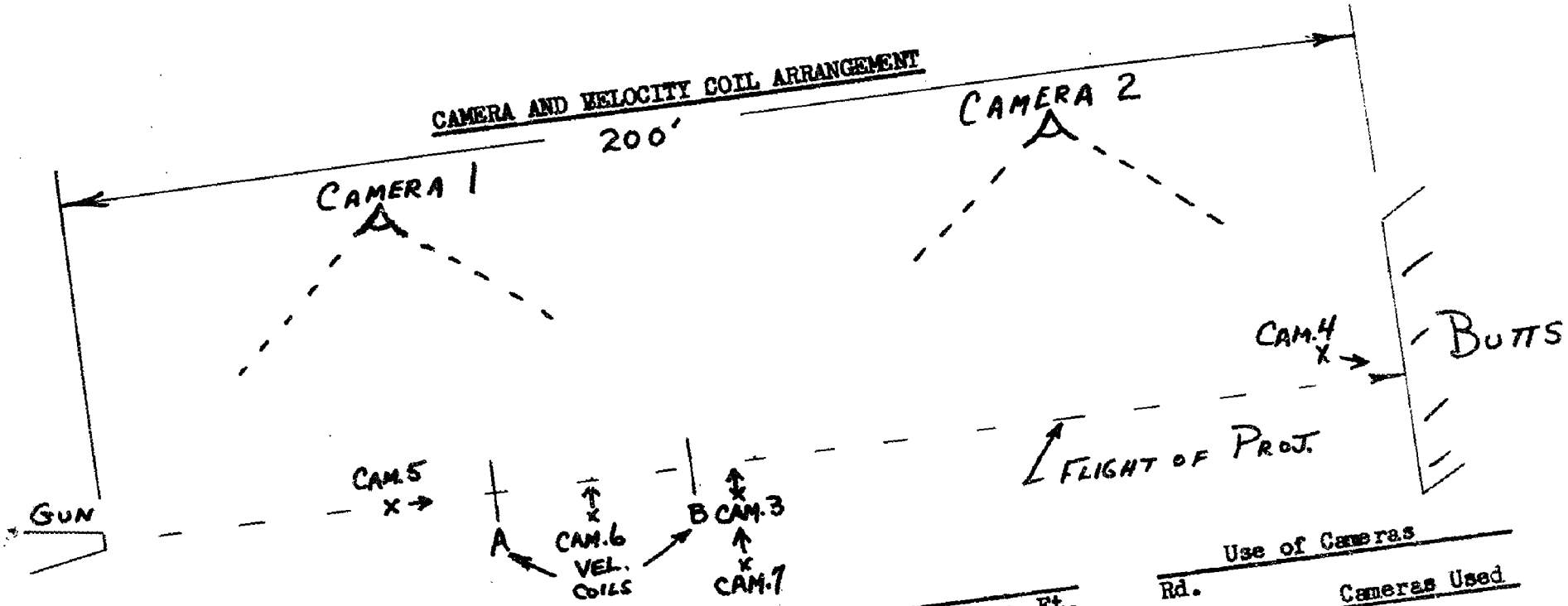
LRS-30092 19 May 1952 SECURITY INFORMATION

5" A. S. Proj., EX-30, No. 3 after recovery from sawdust. Round 7. Three views (120° apart).

Figure 16

NP9-50693 19 May 1952 CONFIDENTIAL SECURITY INFORMATION
Yaw card, 200 ft. from muzzle, describing flight of 5" A. S. Projectil
EX-30. Rounds 6 and 7 (top to bottom).
Figure 17

CAMERA AND VELOCITY COIL ARRANGEMENT



Rd. No.	Position Velocity Coils Feet from Muzzle A	B
1	75.0	125.0
2	75.0	125.0
3	46.4	91.4
4	46.4	91.4
5	40.0	60.0
6	40.0	60.0
7	40.0	60.0

Position No.	Camera Type	Approx. Ft. From Muzzle
1	35mm Mitchell	50
2	35mm Mitchell	150
3	35mm Fastax	100
4	35mm Fastax	180
5	16mm Fastax	35
6	Speed Graphic	75
7	Ballistic Synchro	90

Rd. No.	Use of Cameras Cameras Used
1	1, 2
2	1, 2
3	1*, 2*, 3
4	1, 2*, 5, 6, 7
5	1, 2, 3, 4*, 5
6	1, 2, 3, 4, 5
7	1, 2, 3, 4, 5

FIGURE 18

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TWENTY-ONE ROLLS OF MOVIE FILM

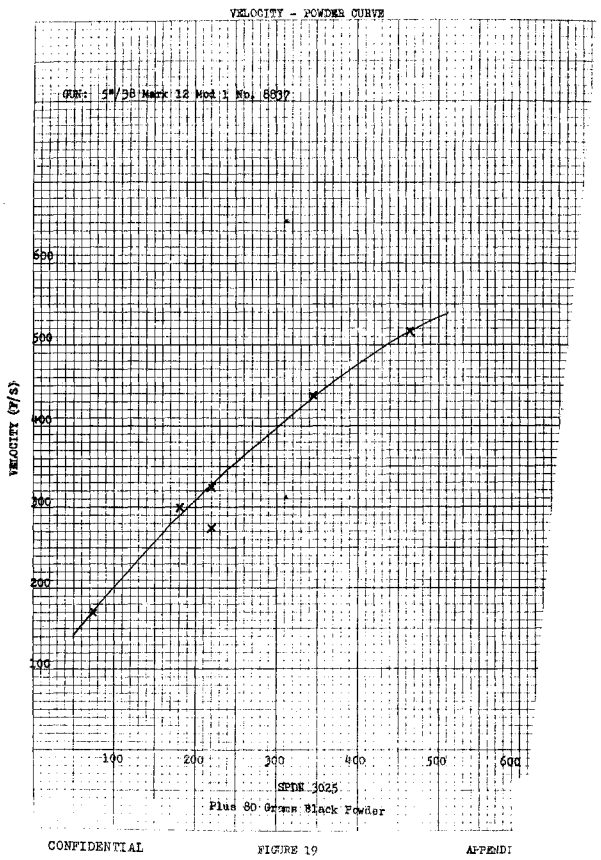
FORWARDED TO BUORD (Re3b) UNDER

SEPARATE COVER

TABLE I

FIRING RECORD

Date of Test	Rd. No.	Projectile BUORD No.	Projectile Batt. Ltr.	Projectile Wt. (lbs.)	Powder Charge (grams) B.P. plus SPDN 3025	Est. Muzz. Vel. (f/s)	Comments
6 March 1952	1	2	TIR-2	74.90	80 72	170	Hit ground 120 ft. from muzzle.
6 March 1952	2	1	TIR-1	75.15	80 180	300	Hit ground at foot of sawdust bin.
11 April 1952	3	5	MIE-1	75.05	80 344	438	Recovered from sand pile.
14 April 1952	4	9	MIE-2	75.15	80 472	517	Ricocheted from sand into river.
19 May 1952	5	7	ZIJ-2	74.90	80 210	Miss.	Recovered from sawdust - 30 ft. penetration.
19 May 1952	6	6	ZIJ-3	74.75	80 210	323	Recovered from sawdust - 18 ft. penetration.
19 May 1952	7	3	ZIJ-1	75.00	80 210	274	Recovered from sawdust - 32 ft. penetration.



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STI-ATI-202 063 25-1575 ~~CONFIDENTIAL~~ SECURITY INFORMATION

Naval Proving Ground, Dahlgren, Va. P1911

TASK ASSIGNMENT NPG-Re3b-239-1-52 - 5" ANTI-SUBMARINE PROJECTILE EX-30, by R. D. Cromwell. First Partial Rept. 8 Sep 52. 8p illus, tables. Rept no. 1044 U

Ordnance (22)
Ammunition & Explosives (1)

Armament, Antisubmarine Projectiles

~~Copies obtainable from ASTIA-DSC~~

Antisubmarine Armament

NTIS, Auth: CNSWC notice 6 Jan 76

MICROFILM

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U Auth: NSWC notice, 6 Jan 76